AMITY UNIVERSITY
UTTAR PRADESH

Course Title: Antenna Theory and Design
Course Code: ECE642
Credit Units: 6
Course Level: PG

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	1	4	0	6

Course Objectives: This course provides comprehensive knowledge about different antennas such as resonant antenna, array antenna, broad band antenna, aperture antenna and smart antenna. This covers antenna synthesis and different computational electromagnetic methods for antenna design.

Prerequisites: Antenna and Wave Propagation

Course contents/Syllabus:

	Weightage (%)
Module I : Antenna Fundamentals and Definitions Radiation mechanism and Basic Definitions- Solution for radiation from a Hertzian dipole, near and far-field regions, radiation patterns, beamwidth, directivity and gain, antenna Impedance, radiation resistance, radiation efficiency, Co- and cross polarization	**20%**
Module II: Elementary Antennas, Array Theory and Different Types of Antennas Elementary Antennas- Short dipole, half wave dipole, quarter wave monopole. Electrically small loop antenna. Arrays- Two-element array. Equi-spaced uniformly excited linear arrays, pattern multiplication, broadside array, end-fire array. Equi-spaced non- uniformly excited linear arrays, Phased arrays and feeding techniques. Planar arrays, Design Consideration, Circular arrays and Perspective on arrays. Patch Antennas- Microstrip rectangular and circular patch antennas-Analysis and design, feeding methods. 2- element and 2x2 rectangular patch arrays and feed network. Slot and notch antennas. Broad band Antennas- Principles of broadbanding and frequency- independent concept. Traveling wave antennas, Log-periodic antennas, Bi-conical antennas and Planar spiral antennas.Reflector Antennas- Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, offset parabolic reflectors, Gain calculations for reflector antennas, feed antennas for reflectors. Other Antennas - Folded dipole, Yagi-antenna, Sleeve antenna, Helical antenna. Lens Antennas, Frequency selective surfaces and periodic	**20%**

structures, Metamaterial based antenna.	
Module III: Smart Antenna	**20%**
Smart antenna analogy, Cellular Radio Systems evolution, smart antennas benefits, Smart antennas draw backs, Antenna beam forming, smart antenna design, simulation and results. Beam forming, Diversity Combining, Rayleigh – fading and Trellis - Coded Modulation	
Module IV: Antenna Synthesis	**20%**
Formulation of synthesis problem, synthesis principles, line sources shaped beam synthesis, linear array shaped beam synthesis — Fourier Series, Woodward — Lawson sampling method, comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods Dolph- Chebyshev linear array, Taylor line source method.	
Module V: Computational Methods	**20%**
Method of Moments - Introduction to Method of Moments, Pocklington's integral equation, integral equations and Kirchoff's Networking Equations, Source Modeling Weighted residuals formulations and computational consideration, calculation of antenna and scatter characteristics.	

Student Learning Outcomes:

- To define overall needs and constraints of RF systems and antenna.
- The ability to develop and assess alternative RF system designs based on technical criteria
- The technical ability to analyze a prescribed communication sub-system Analyze and attract the vital resources required to effectively use a RF system.
- To identify and solve the technical requirements of the communication system and its impact on the global society
- Evaluate the opportunities involving technology, a product or a service required for developing a startup idea.

Pedagogy for Course Delivery: The class will be taught using theory and numerical based method. The course instructor will spend considerable time in understanding of the concept and its application in real life problems. The course instructor will spend considerable time in understanding of the concept and its application in real life problems. The instructor will cover the ways to think innovatively liberally using thinking techniques.

List of Laboratory Experiment:

1. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of rectangular patch antenna.
2. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of planar dipole antenna.
3. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of planar slot antenna.
4. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of planar yagi antenna.
5. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of planar sleeve dipole antenna.
6. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of planar log periodic antenna.

7. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of folded dipole antenna.
8. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of helix antenna.
9. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of planar notch antenna.
10. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of strip dipole antenna.
11. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of single patch EM coupled antenna.
12. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of two patch EM coupled antenna.
13. To study and analyze the output characteristics (i.e. return loss, Gain and Radiation Pattern) of 2X2 array EM coupled antenna.
14. Simulation of patch antenna (in the frequency range of 2 – 3 GHz) by using HFSS software.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical (%)	Total
66.67%	33.33%	100%

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment					End Term Examination
Components (Drop down)	Mid-Term Exam(CT)	**S/V/Q**	**HA**	Attendance(A)	
Weightage (%)	10%	8%	7%	5%	70%

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

Lab Assessment (P):

Continuous Assessment/Internal Assessment					End Term Examination
Components (Drop down)	**PR**	**LR**	V	A	

Weightage (%)	10%	10%	5%	5%	70%

A: Attendance, PR- Performance, LR – Lab Record, V – Viva. EE- External Exam,

Text & Refernces:

- Stutzman and Thiele, "Antenna Theory and Design", 2ndEd, John Wiley and Sons Inc.
- C. A. Balanis: "Antenna Theory Analysis and Design", John Wiley, 3rd Edition, 2012.
- Kraus, "Antennas", McGraw Hill, TMH, 3" Edition, 2003
- Kraus and R.J. Marhefka:, "Antennas", McGraw Hil1, 2nd Edition, 1998
- A.R. Harish and M. Sachidananda, Antennas and Wave Propagation, Oxford Univ. Press, 2007.